# PATENT ABSTRACTS OF JAPAN

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(54) SURFACE ACOUSTIC WAVE DEVICE AND MANUFACTURING METHOD THEREOF

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a small-sized surface acoustic wave device with a low profile and high reliability.

SOLUTION: The surface acoustic wave device 1 comprises: an interdigital electrode section 4 formed on a piezoelectric substrate 3 on the rear side of which a protection film 11 is formed; a reflector (not shown); a protection member 6 formed around a surface part (function part) such as the interdigital electrode section 4 on which a surface acoustic wave is propagated; a surface acoustic wave element 2 formed with the surface part (function part) such as the interdigital electrode section 4 on which the surface acoustic wave is propagated and a protection film 8 adhered to the piezoelectric substrate 3 in a way of

covering the protection member 9; a bump 7 formed on the electrode pad 6; a sealing reinforcement resin 10 for covering the adhered part of the protection film 8 to the photoelectric conversion element substrate; and a joining substrate 12 with which the surface acoustic wave element is joined while the face of the surface acoustic wave having the interdigital electrode section 4 is opposed via the bump 7 and which has an electrode land 13, a via-hole 14 and an external terminal 15.

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* NOTICES *

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CLAIMS

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[Claim(s)]

[Claim 1]

The surface acoustic element which has a piezo-electric substrate, and the functional division and bump who were formed on this piezo-electric substrate, and who go away at least one and consist of mold polar zone,

The protection member formed in the perimeter of said functional division on said piezo-electric substrate,

The protection film pasted up on said piezo-electric substrate as covered said functional division and said protection member,

It has the junction substrate to which said surface acoustic element made the field which has said comb mold polar zone counter, and was joined by said bump,

Surface acoustic wave equipment characterized by said protection film consisting of a liquid crystal polymer.

[Claim 2]

The surface acoustic element which has a piezo-electric substrate, and the functional division and bump who were formed on this piezo-electric substrate, and who go away at least one and consist of mold polar zone,

The protection member formed in the perimeter of said functional division on said piezo-electric substrate,

The protection film pasted up on said piezo-electric substrate as covered said functional division and said protection member,

It has the junction substrate to which said surface acoustic element made the field which has said comb mold polar zone counter, and was joined by said bump, Surface acoustic wave equipment characterized by for said protection film being the multilayer structure the metal layer or whose ceramic layer was pinched in the resin layer, and a steam transmission coefficient being below 6.9x10 -11 [g-m/m2andS].

[Claim 3]

Surface acoustic wave equipment given in either of claims 1 and 2 which is characterized by having further resin for closure reinforcement prepared as covered a part for jointing and the piezo-electric substrate of a perimeter with said piezo-electric substrate of said protection film.

[Claim 4]

Said junction substrate is surface acoustic wave equipment to claim 1 thru/or either of 3 which is characterized by having the beer hall which connects an external terminal, an electrode land, and this external terminal and an electrode land.

[Claim 5]

They are plurality and the process to produce about the surface acoustic element which has the functional division which goes away on [ at least one ] a piezo-electric substrate, and consists of mold polar zone,

The process which forms a protection member in the perimeter of the functional division of two or more of said surface acoustic elements,

The process which pastes up the protection film which consists of a liquid crystal polymer as covers two or more of said functional divisions and said protection members of a surface acoustic element on said piezo-electric substrate with either [ at least ] heat or a pressure,

The process which forms a bump in said surface acoustic element,

The process which prepares the set substrate of the junction substrate which has the beer hall which connects an external terminal, an electrode land, and this external terminal and an electrode land,

The process which the field which has said comb mold polar zone for said two or more surface acoustic elements is made to counter, and is joined to said set substrate through a bump,
The manufacture approach of the surface acoustic wave equipment characterized by having the process which cuts down each surface acoustic wave equipment from said set substrate.
[Claim 6]
They are plurality and the process to produce about the surface acoustic element which has the functional division which goes away on [ at least one ] a piezo-electric substrate, and consists of mold polar zone,
The process which forms a protection member in the perimeter of the functional division of two or more of said surface acoustic elements,
The process which pastes up the protection film whose steam transmission coefficient it is the multilayer structure the metal layer or whose ceramic layer was pinched in the resin layer as covered two or more of said functional divisions and said protection members of a surface acoustic element, and is below 6.9x10 -11 [g-m/m2andS] on said piezo-electric substrate with either [ at least ] heat or a pressure,
The process which forms a bump in said surface acoustic element,
The process which prepares the set substrate of the junction substrate which has the beer hall which connects an external terminal, an electrode land, and this external terminal and an electrode land,
The process which the field which has said comb mold polar zone for said two or more surface acoustic elements is made to counter, and is joined to said set substrate through a bump,
The manufacture approach of the surface acoustic wave equipment characterized by having the process which cuts down each surface acoustic wave equipment from said set substrate.
[Claim 7]
The manufacture approach of surface acoustic wave equipment given in either of

claims 5 and 6 which is characterized by having a wrap process for a part for jointing and the piezo-electric substrate of a perimeter with said piezo-electric substrate of said protection film by the resin for closure reinforcement after the process which forms a bump in said surface acoustic element.

[Claim 8]

They are plurality and the process to produce about the surface acoustic element which has the functional division which goes away on [ at least one ] a piezo-electric substrate, and consists of mold polar zone,

The process which forms a protection member in the perimeter of the functional division of two or more of said surface acoustic elements,

The process which forms a bump in said surface acoustic element,

The process which pastes up the protection film which consists of a liquid crystal polymer as covers two or more of said functional divisions and said protection members of a surface acoustic element on said piezo-electric substrate with either [ at least ] heat or a pressure,

The process which prepares the set substrate of the junction substrate which has the beer hall which connects an external terminal, an electrode land, and this external terminal and an electrode land,

The process which the field which has said comb mold polar zone for said two or more surface acoustic elements is made to counter, and is joined to said set substrate through a bump,

The manufacture approach of the surface acoustic wave equipment characterized by having the process which cuts down each surface acoustic wave equipment from said set substrate.

[Claim 9]

They are plurality and the process to produce about the surface acoustic element which has the functional division which goes away on [ at least one ] a piezo-electric substrate, and consists of mold polar zone,

The process which forms a protection member in the perimeter of the functional division of two or more of said surface acoustic elements,

The process which forms a bump in said surface acoustic element,
The process which pastes up the protection film whose steam transmission coefficient it is the multilayer structure the metal layer or whose ceramic layer was pinched in the resin layer as covered two or more of said functional divisions and said protection members of a surface acoustic element, and is below 6.9x10 -11 [g-m/m2andS] on said piezo-electric substrate with either [ at least ] heat or a pressure,
The process which prepares the set substrate of the junction substrate which has the beer hall which connects an external terminal, an electrode land, and this external terminal and an electrode land,
The process which the field which has said comb mold polar zone for said two or more surface acoustic elements is made to counter, and is joined to said set substrate through a bump,
The manufacture approach of the surface acoustic wave equipment characterized by having the process which cuts down each surface acoustic wave equipment from said set substrate.
[Claim 10]
The manufacture approach of surface acoustic wave equipment given in either of claims 8 and 9 which is characterized by having a wrap process for a part for jointing and the piezo-electric substrate of a perimeter with said piezo-electric substrate of said protection film by the resin for closure reinforcement after the process which pastes up a protection film on said piezo-electric substrate with either [ at least ] heat or a pressure as covers two or more of said functional divisions and said protection members of a surface acoustic element.

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[Translation done.]

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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention]

Especially this invention relates to the surface acoustic wave equipment which carried the surface acoustic element in the package with respect to surface acoustic wave equipment.

[0002]

[Description of the Prior Art]

In recent years, the small and lightweight surface acoustic wave equipment as a filter carried in such mobile communication equipment is used abundantly with RF[ the miniaturization of mobile communication equipment, such as a land mobile radiotelephone machine or a portable telephone, lightweight-izing, and ]-izing.

[0003]

In surface acoustic wave equipment, in order to use the surface acoustic wave which spreads the front-face top of a piezo-electric substrate, it is necessary to protect the surface part (functional division) which this surface acoustic wave spreads from moisture, dust, etc. Therefore, the package approach of conventional surface acoustic wave equipment had the structure in use which mounts a surface acoustic element in the package which consists of an alumina etc. by wirebonding or flip chip bonding, and is closed by lid material.

[0004]

However, with such structure, unless the package which carries a surface

acoustic element was miniaturized in the place which miniaturized the surface acoustic element by the advancement of the technique of detailed wiring, there was a problem that miniaturization and low back-ization of surface acoustic wave equipment could not be performed.

[0005]

Then, the surface acoustic wave equipment adapting the chip-size package using the flip chip bonding used in the field of current and semi-conductor components is developed.

[0006]

Above conventional surface acoustic wave equipment is concretely explained using drawing 6 . The field which has the comb mold polar zone 54 is made to counter the junction substrate 62 which has the electrode land 63, a beer hall 64, and the external terminal 65 for the surface acoustic element 52 which formed the comb mold polar zone 54 and the electrode pad 56 with metals, such as aluminum, on the piezo-electric substrate 53, and it joins to it by flip chip bonding. At this time, the beer hall 64 and the electrode land 63 which are connected with a surface acoustic element 52, the external terminal 65, and it are electrically connected through a bump 57. And in order to protect the surface part (functional division) which the surface acoustic wave containing the comb mold polar zone 54 spreads, as a surface acoustic element 52 is covered, the film 66 which consists of plastics is pasted up on the junction substrate 62. And in order to raise confidentiality, it is surface acoustic wave equipment 51 which was closed by closure resin 67 from on the film 66.

[0007]

Moreover, deformation films, such as a film to which plastic film, the conductive film, or the metal was made to adhere, are pasted up with the structure shown in drawing 6 , and the structure closed by closure resin on it is known (patent reference 1 reference). Furthermore, in order to raise confidentiality, it replaces with closure resin and the structure using the 2nd deformation film is also indicated (patent reference 1 reference).

[0008]

[Patent reference 1]

JP,2001-176995,A

[0009]

[Problem(s) to be Solved by the Invention]

However, in the structure currently indicated by the structure and the patent reference 1 which were shown in drawing 6 , only with a film, since confidentiality is inadequate and it closes by closure resin from on a film, low back-ization of the part of the thickness of resin and surface acoustic wave equipment will be difficult.

[0010]

Furthermore, as a surface acoustic element is covered, in order to paste up a film on a junction substrate, the part which pastes up a film is needed for a junction substrate, and the miniaturization of surface acoustic wave equipment is also difficult.

[0011]

Moreover, without using resin, when the structure using the 2nd deformation film of adhesion with the substrate of a deformation film is inadequate, the problem that confidentiality is not securable occurs.

[0012]

The surface acoustic wave equipment of this invention is made in view of an above-mentioned problem, solves these problems, and it is small and the low back and it aims at offering reliable surface acoustic wave equipment.

[0013]

[Means for Solving the Problem]

In order to attain the above-mentioned purpose, the surface acoustic wave equipment of this invention The surface acoustic element which has a piezo-electric substrate, and the functional division and bump who were formed on this piezo-electric substrate, and who go away at least one and consist of mold polar zone, The protection film pasted up on said piezo-electric substrate as covered the protection member formed in the perimeter of said functional division on said

piezo-electric substrate, and said functional division and said protection member, It has the junction substrate to which said surface acoustic element made the field which has said comb mold polar zone counter, and was joined by said bump, and is characterized by said protection film consisting of a liquid crystal polymer.

[0014]

Moreover, another surface acoustic wave equipment of this invention The surface acoustic element which has a piezo-electric substrate, and the functional division and bump who were formed on this piezo-electric substrate, and who go away at least one and consist of mold polar zone, The protection film pasted up on said piezo-electric substrate as covered the protection member formed in the perimeter of said functional division on said piezo-electric substrate, and said functional division and said protection member, It has the junction substrate to which said surface acoustic element made the field which has said comb mold polar zone counter, and was joined by said bump. It is characterized by for said protection film being the multilayer structure the metal layer or whose ceramic layer was pinched in the resin layer, and a steam transmission coefficient being below 6.9x10 -11 [g-m/m2andS].

[0015]

It is desirable to have resin for wrap closure reinforcement for a part for jointing and the piezo-electric substrate of a perimeter with said piezo-electric substrate of said protection film further.

[0016]

Moreover, as for said junction substrate, it is desirable to have the beer hall which connects an external terminal, an electrode land, and this external terminal and an electrode land.

[0017]

Moreover, the manufacture approach of the first surface acoustic wave equipment of this invention The surface acoustic element which has the functional division which goes away on [ at least one ] a piezo-electric substrate, and consists of mold polar zone Plurality and the process to produce, The

process which forms a protection member in the perimeter of the functional division of two or more of said surface acoustic elements, Two or more of said functional divisions and said protection members of a surface acoustic element are covered. The process which pastes up the protection film which consists of a liquid crystal polymer on said piezo-electric substrate with either [ at least ] heat or a pressure, The process which forms a bump in said surface acoustic element, an external terminal, and an electrode land, The process which prepares the set substrate of the junction substrate which has the beer hall which connects an electrode land with this external terminal, It is characterized by having the process which the field which has said comb mold polar zone for said two or more surface acoustic elements is made to counter, and is joined to said set substrate through a bump, and the process which cuts down each surface acoustic wave equipment from said set substrate.

[0018]

Moreover, the manufacture approach of the second surface acoustic wave equipment of this invention The surface acoustic element which has the functional division which goes away on [ at least one ] a piezo-electric substrate, and consists of mold polar zone Plurality and the process to produce, The process which forms a protection member in the perimeter of the functional division of two or more of said surface acoustic elements, Two or more of said functional divisions and said protection members of a surface acoustic element are covered. The process which pastes up the protection film whose steam transmission coefficient it is the multilayer structure the metal layer or whose ceramic layer was pinched in the resin layer, and is below 6.9x10 -11 [g-m/m2andS] on said piezo-electric substrate with either [ at least ] heat or a pressure, The process which forms a bump in said surface acoustic element, an external terminal, and an electrode land, The process which prepares the set substrate of the junction substrate which has the beer hall which connects an electrode land with this external terminal, It is characterized by having the process which the field which has said comb mold polar zone for said two or

more surface acoustic elements is made to counter, and is joined to said set substrate through a bump, and the process which cuts down each surface acoustic wave equipment from said set substrate.

[0019]

In addition, in the first [ of this invention ], and second manufacture approaches of surface acoustic wave equipment, it is desirable to have a wrap process for a part for jointing and the piezo-electric substrate of a perimeter with said piezo-electric substrate of said protection film by the resin for closure reinforcement after the process which forms a bump in said surface acoustic element.

[0020]

Moreover, the manufacture approach of the third surface acoustic wave equipment of this invention The surface acoustic element which has the functional division which goes away on [ at least one ] a piezo-electric substrate, and consists of mold polar zone Plurality and the process to produce, The process which forms a protection member in the perimeter of the functional division of two or more of said surface acoustic elements, The process which forms a bump in said surface acoustic element, and the functional division and said protection member of two or more of said surface acoustic elements are covered. The process which pastes up the protection film which consists of a liquid crystal polymer on said piezo-electric substrate with either [ at least ] heat or a pressure, The process which prepares the set substrate of the junction substrate which has the beer hall which connects an external terminal, an electrode land, and this external terminal and an electrode land, It is characterized by having the process which the field which has said comb mold polar zone for said two or more surface acoustic elements is made to counter, and is joined to said set substrate through a bump, and the process which cuts down each surface acoustic wave equipment from said set substrate.

[0021]

Moreover, the manufacture approach of the fourth surface acoustic wave equipment of this invention The surface acoustic element which has the

functional division which goes away on [ at least one ] a piezo-electric substrate, and consists of mold polar zone Plurality and the process to produce, The process which forms a protection member in the perimeter of the functional division of two or more of said surface acoustic elements, The process which forms a bump in said surface acoustic element, and the functional division and said protection member of two or more of said surface acoustic elements are covered. The process which pastes up the protection film whose steam transmission coefficient it is the multilayer structure the metal layer or whose ceramic layer was pinched in the resin layer, and is below 6.9x10 -11 [g-m/m2andS] on said piezo-electric substrate with either [ at least ] heat or a pressure, an external terminal, and an electrode land, The process which prepares the set substrate of the junction substrate which has the beer hall which connects an electrode land with this external terminal, It is characterized by having the process which the field which has said comb mold polar zone for said two or more surface acoustic elements is made to counter, and is joined to said set substrate through a bump, and the process which cuts down each surface acoustic wave equipment from said set substrate.

[0022]

In addition, in the manufacture approach of the third of this invention, and the fourth surface acoustic wave equipment, it is desirable to have a wrap process for a part for jointing and the piezo-electric substrate of a perimeter with said piezo-electric substrate of said protection film by the resin for closure reinforcement after the process which pastes up a protection film on said piezo-electric substrate with either [ at least ] heat or a pressure as covers two or more of said functional divisions and said protection members of a surface acoustic element.

[0023]

[Embodiment of the Invention]

Hereafter, the example of this invention is explained based on drawing.

The sectional view showing the example of surface acoustic wave equipment [ in

/ in drawing 1 / this invention ], the top view of a surface acoustic element [ in / in drawing 2 / the example of this invention ], each process drawing of the manufacture approach of surface acoustic wave equipment [ in / in drawing 3 / the example of this invention ], each process drawing of the manufacture approach of surface acoustic wave equipment [ in / in drawing 4 / the example of this invention ], and drawing 5 are the top views of the surface acoustic element mounted in the set substrate (junction substrate) in the example of this invention.

[0024]

The surface acoustic wave equipment 1 of this invention consists of a surface acoustic element 2 and a junction substrate 12, as shown in drawing 1 . The piezo-electric substrate 3 with which, as for the surface acoustic element 2, the protective coat 11 was formed in the rear face, Please form on this piezo-electric substrate 3, and it carries out. The mold polar zone 4, a reflector (not shown), and the electrode pad 6, The protection member 9 thicker than electrode layer thickness formed in the perimeter of the surface part (functional division) which surface acoustic waves, such as the comb mold polar zone 4, spread, The piezo-electric substrate 3 a part for jointing and around [ its ] the piezo-electric substrate of the protection film 8 pasted up on the piezo-electric substrate 3 as covered the above-mentioned functional division and the above-mentioned protection member 9, and the protection film 8 consists of resin 10 for wrap closure reinforcement. In addition, although stuck with the protection member 9, the protection film 8 is formed so that the comb mold polar zone 4, a reflector (not shown), the electrode pad 6, etc. may not be contacted.

[0025]

To the junction substrate 12 which has the electrode land 13, a beer hall 14, and the external terminal 15, a surface acoustic element 2 is in the condition which the field which has the comb mold polar zone 4 was made to counter, and is joined through the bump 7 formed on the electrode pad 6.

[0026]

the protective coat 11 which prevents the crack of a piezo-electric substrate

when piezo-electric substrates, such as LiTaO3, are used for the rear face of a surface acoustic element 2 is only formed -- it is -- surface acoustic wave equipment 1 -- small -- and -- low -- it has **** structure. In addition, if a piezo-electric substrate cannot break easily, it is not necessary to form this protective coat 11.

[0027]

The protection film 8 used by this invention needs to be high barrier property, in order to protect especially the surface part (functional division) that a surface acoustic wave spreads from moisture. Then, it evaluated by preparing various films. The following evaluations are the evaluations after changing only a film using the surface acoustic element whose frequency characteristics are 1.9GHz. In addition, decision of the excellent article at the time of characterization and a defective used as the defective the case where 0.3dB or more of insertion losses got worse.

[0028]

First, the correlation of the steam transmission coefficient of the protection film 8 and the rate of a property excellent article of surface acoustic wave equipment was investigated using the film of the monolayer which consists of polyimide, and the film of the multilayer structure which consists of polyimide and aluminum 2O3. It was made for all the thickness of a protection film to be set to 100 micrometers at this time. While only the part needs to make a bump high, and it is more desirable as this has a bump's low height for the reduction in the back when actually using for surface acoustic wave equipment, and a protection film becomes thick, a bump 100 micrometers or more is made because it took into consideration that they were difficulty and high cost.

[0029]

In addition, by forming aluminum 2O3 on polyimide, and increasing the thickness of aluminum 2O3 gradually, the film of multilayer structure prepared the sample to which the steam transmission coefficient of a protection film was changed, and performed the reliability trial about each.

[0030]
The evaluation sample was performed with the structure which pasted up the protection film on the piezo-electric base as covered the surface part (functional division) and protection member which a surface acoustic wave spreads after forming the protection member in the perimeter of the surface part (functional division) which the surface acoustic wave of a surface acoustic element spreads, and the number of property excellent articles after the chamber 2000-hour neglect in ** estimated it.
[0031]
Here, the steam transmission coefficient used for evaluation of a property is a multiplier [g-m/m2andS] which is the protection film whose thickness is 1m, and means the steam of the weight (g) of which penetrates to unit time amount (S) and per [ an unit area (m2) ]. It will be said that a steam transmission coefficient shows the amount of steam transparency per unit thickness, and is a value which is not related to film thickness, and its effectiveness as barrier to a steam is so large that a multiplier is small.
[0032]
The result of an evaluation trial **1 Polyimide (100 micrometers): g-m/m2and2.3x10-8[S] =1 / 100 (it means that the number per 100 evaluation samples and of excellent article samples is one.) the following -- the same . **2 g-m/m2andpolyimide (99.5 micrometers) +aluminum2O3(0.5 micrometers):9.7x10-10[S] =9/100, **3 g-m/m2andpolyimide (99 micrometers) +aluminum2O3(1 micrometer):6.9x10-11[S] =91/100, **4 g-m/m2andpolyimide (95 micrometers) +aluminum2O3(5 micrometers):3.5x10-11[S] =99/100, **5 g-m/m2andpolyimide (90 micrometers) +aluminum2O3(10 micrometers):1.2x10-11[S] =99/100, **6 g-m/m2andpolyimide (80 micrometers) +aluminum2O3(20 micrometers):8.8x10-12[S] =100/100, **7 g-m/m2andpolyimide (75 micrometers) +aluminum2O3(25 micrometers):5.0x10-12[S] =100/100, **8 It was g-m/m2andpolyimide (50 micrometers) + copper foil (25 micrometers) +aluminum2O3(25 micrometers):5.0x10-13[S] =100/100.

[0033]
It turns out that a property stops being able to deteriorate easily, so that the thickness of aluminum 2O3 is increased and the steam transmission coefficient of a protection film is made small from the above result. Especially, it turns out that 90% or more can maintain [ a steam transmission coefficient ] property excellent article criteria only with the barrier property of a protection film at the time of 6.9x10-11 [g-m/m2andS]. Furthermore, it turns out below by 3.5x10 -11 [g-m/m2andS] that 99% or more can maintain property excellent article criteria only with the barrier property of a protection film. Although the polyimide film was used as a resin layer this time, not only this but polyethylenenaphthalate etc. should just be a film with thermal resistance.
[0034]
Moreover, although the above-mentioned result is the thing of the film of the monolayer which consists of polyimide, and the film of the multilayer structure which consists of polyimide and aluminum 2O3, as an ingredient with which a steam transmission coefficient becomes below 6.9x10 -11 [g-m/m2andS], there is a liquid crystal polymer with the film of a monolayer. 3.0x10-11 [g-m/m2andS] and the rate of a property excellent article are 100/100, and if the protection film which consists of a liquid crystal polymer is used, the steam transmission coefficient of a liquid crystal polymer can acquire high dependability, even if it is a monolayer.
[0035]
In the film of multilayer structure, while making a steam transmission coefficient small, in order to give a shielding effect to a film, metal layers, such as copper foil, may be formed between resin layers. However, a resin layer and a metal layer may short-circuit, if the film which has a metal layer in the top where the adhesion force is weak contacts a bump etc. fundamentally. Since the process which forms multilayer structure in addition to these troubles is complicated, it is desirable to use the liquid crystal polymer which can obtain high barrier property by one layer as a protection film 8.

[0036]

The manufacture approach of the surface acoustic wave equipment 1 concerning this invention is as follows.

[0037]

first, on the piezo-electric substrate 3, after applying a resist, if it exposes using a mask, the resist pattern for lift off (not shown) which has a desired opening pattern will be formed using the photolithography technique acquired and said.

[0038]

Next, by making resist exfoliation liquid immerse and rock and exfoliating a resist pattern in it (lift off), after forming aluminum which is an electrode material metal with vacuum deposition etc., as shown in drawing 3 (a), the comb mold polar zone 4, a reflector 5, the electrode pad 6, leading-about wiring, etc. are formed on the piezo-electric substrate 3, and the surface acoustic element 2 as shown in drawing 2 is produced.

[0039]

As a piezo-electric substrate, LiTaO3, LiNbO3, Xtal, and Li2B4O7 grade are used according to a target property. Moreover, as an electrode material, it is possible to use metallic materials, such as Au, Cu, nickel, Ta, and W, in addition to aluminum.

[0040]

if a photopolymer is applied to the field which went away piezo-electric substrate 3 and formed the mold polar zone 4 etc. continuously and it exposes to it using a mask, as shown in drawing 3 (b) using the photolithography technique acquired and said, it will form in it annularly so that the surface part (functional division) into which surface acoustic waves, such as the comb mold polar zone 4, spread the protection member 9 which consists of a resin pattern thicker than the comb mold polar zone 4 may be surrounded. At this time, the protection film 8 described later just prevents contacting the comb mold polar zone 4 and a reflector 5 as thickness of the protection member 9. For example, when the thickness of the comb mold polar zone 4 and a reflector 5 is about 0.2

micrometers, there should just be about 5 micrometers of thickness of the protection member 9. The protective coat 11 which consists of an epoxy resin or resin called polyimide is formed in the field in which it goes away piezo-electric substrate 3 with it, and the mold polar zone 4 etc. is formed. When LiTaO3 substrate which is easy to break is used as a piezo-electric substrate 3, the crack of a substrate can be prevented by forming a protective coat 11.

[0041]

The protection film 8 which uses for a wrap sake the surface part (functional division) which surface acoustic waves, such as the comb mold polar zone 4, spread, and the protection member 9 is prepared. As a protection film 8, what consists of a liquid crystal polymer with a thickness of 44 micrometers is used. Since a steam transmission coefficient has 3.0x10-11 [g-m/m2andS] and high barrier property so that the result of the above-mentioned evaluation may show, the liquid crystal polymer is suitable to protect the functional division of a surface acoustic element 2 from moisture or dust.

[0042]

In addition, although the film which consists of a liquid crystal polymer as a protection film 8 was used in this example, this invention may use the film which has multilayer structure, such as having a metal layer and a ceramic layer, not only between this but between resin layers. If a steam transmission coefficient is below 6.9x10 -11 [g-m/m2andS], the surface part (functional division) which a surface acoustic wave spreads only with the protection film 8 can be protected from moisture or dust.

[0043]

The film of multilayer structure prepares Si substrate with which the front face was ground, carries out temporary adhesion of the polyimide film with a thickness of 25 micrometers on Si substrate, sticks copper foil with a thickness of 10 micrometers formed by rolling on it, further, on it, it sticks a polyimide film with a thickness of 25 micrometers, heats it, putting a pressure with a press machine, and sticks a polyimide film and copper foil by pressure. What is necessary is to

apply an adhesives layer and just to form on it, furthermore.

[0044]

As the functional division of a surface acoustic element 2, a protection member, and 9 are covered and it is shown in drawing 3 (c) with the prepared protection film 8, thermocompression bonding of the protection film 8 is carried out to the piezo-electric substrate 3. At this time, adhesion temperature is 300 degrees C, and while becoming easy to process the protection film 8, the oxidation and diffusion of an electrode by heat serve as temperature which does not pose a problem. It becomes possible to protect the functional division of a surface acoustic element 2 from moisture, dust, etc. with the protection film 8, securing the oscillating space of a surface acoustic wave by carrying out like this.

[0045]

And as shown in drawing 4 (a), the bump 7 who consists of Au is formed on the electrode pad 6. A bump's 7 height is set to 20-30 micrometers. Although the bump who consists of Au as a bump 7 was used in this example, the bump who consists not only of this but of solder may be used. However, when using the bump who consists of solder of an Au-Sn system or a Sn-Ag system, it is desirable to form nickel layer on the electrode pad 6 as an adhesion layer of the bump who consists of solder.

[0046]

Moreover, in this example, after pasting up the protection film 8 on the piezo-electric substrate 3 of a surface acoustic element 2, the bump 7 was formed, but this invention may paste up the protection film 8 on the piezo-electric substrate 3 of a surface acoustic element 2, after forming not only this but the bump 7.

[0047]

As shown in drawing 4 (b), in a surface acoustic element 2, the resin 10 for closure reinforcement is applied and stiffened so that a part for jointing with the piezo-electric substrate 3 of the protection film 8 may be covered. The resin 10 for closure reinforcement is the thickness to which the height of the front face of the resin 10 for closure reinforcement becomes lower than the protection film 8

on a bump 7 and the protection member 9, and is specifically 10-15 micrometers. Bond strength with the piezo-electric substrate 3 of the protection film 8 can be reinforced with making it like like this, and the airtightness of the closure of the surface part (functional division) which the surface acoustic wave by the protection film 8 spreads can be raised by it.

[0048]

And the set substrate 20 used as the junction substrate 12 is prepared for behind. The through hole 14 which connects electrically the electrode land 13, the external terminal 15, and the electrode land 13 and the external terminal 15 corresponding to the electrode pad 6 of a surface acoustic element 2 to the set substrate 20 (junction substrate 12) is formed. As for the front face of the electrode land 13, it is desirable that Au plating is carried out. Since a bump 7 also consists of Au, bonding strength can be raised in case a surface acoustic element 2 and the junction substrate 12 are joined.

[0049]

As shown in drawing 4 , two or more surface acoustic elements 2 are joined to the prepared set substrate 20 by flip chip bonding. Also electrically and mechanically, the electrode land 13 of the electrode pad 6 of a surface acoustic element 2 and the set substrate 20 is connected through a bump 7.

[0050]

Finally, as dicing shows to drawing 4 (c) from the set substrate 20, surface acoustic wave equipment 1 is obtained.

[0051]

[Effect of the Invention]

Please form the surface acoustic wave equipment of this invention on a piezo-electric substrate, and it carries out. As mentioned above, the mold polar zone, an electrode pad, and a reflector, The protection member formed in the perimeter of the surface part (functional division) which surface acoustic waves, such as comb mold polar zone, spread, The surface acoustic element in which the protection film of high barrier property pasted up on the piezo-electric substrate

as covered the surface part (functional division) and protection member which surface acoustic waves, such as comb mold polar zone, spread was formed, A part for jointing of the piezo-electric substrate of a protection film with the bump formed on the electrode pad The resin for wrap closure reinforcement, Because a surface acoustic element consists of a junction substrate which has the electrode land which the field which has the comb mold polar zone is made to counter, and is joined, a beer hall, and an external terminal and makes it such structure through a bump The surface part (functional division) in a piezo-electric substrate which surface acoustic waves, such as comb mold polar zone, spread securing the oscillating space of a surface acoustic wave Since the hermetic seal of the protection film or steam transmission coefficient which consists of a liquid crystal polymer is carried out and it does not have to carry out the resin seal of the surface acoustic element with the protection film of the multilayer structure below 6.9x10 -11 [g-m/m2andS], a miniaturization and low back-ization are attained.

[0052]

Moreover, since a part for jointing and the piezo-electric substrate of a perimeter with the piezo-electric substrate of a protection film are covered by the resin for closure reinforcement, bond strength with the piezo-electric substrate of a protection film can be reinforced, and the airtightness of the closure of the surface part (functional division) which the surface acoustic wave by the protection film spreads can be raised.

[Brief Description of the Drawings]

[Drawing 1] It is the sectional view showing the example of the surface acoustic wave equipment in this invention.

[Drawing 2] It is the top view of the surface acoustic element in the example of this invention.

[Drawing 3] It is each process drawing of the manufacture approach of the surface acoustic wave equipment in the example of this invention.

[Drawing 4] It is each process drawing of the manufacture approach of the

surface acoustic wave equipment in the example of this invention.

[Drawing 5] It is the top view of the surface acoustic element mounted in the set substrate (junction substrate) in the example of this invention.

[Drawing 6] It is the sectional view of conventional surface acoustic wave equipment.

[Description of Notations]

1 51 Surface acoustic wave equipment

2 52 Surface acoustic element

3 53 Piezo-electric substrate

4 54 Comb mold polar zone

5 Reflector

6 56 Electrode pad

7 57 Bump

8 Protection Film

9 Protection Member

10 Resin for Closure Reinforcement

11 Protective Coat

12 62 Junction substrate

13 63 Electrode land

14 64 Beer hall

15 65 External terminal

20 Set Substrate

66 Film

67 Closure Resin

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[Translation done.]

1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.**** shows the word which can not be translated.

3.In the drawings, any words are not translated.

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## DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] It is the sectional view showing the example of the surface acoustic wave equipment in this invention.

[Drawing 2] It is the top view of the surface acoustic element in the example of this invention.

[Drawing 3] It is each process drawing of the manufacture approach of the surface acoustic wave equipment in the example of this invention.

[Drawing 4] It is each process drawing of the manufacture approach of the surface acoustic wave equipment in the example of this invention.

[Drawing 5] It is the top view of the surface acoustic element mounted in the set substrate (junction substrate) in the example of this invention.

[Drawing 6] It is the sectional view of conventional surface acoustic wave equipment.

[Description of Notations]

1 51 Surface acoustic wave equipment

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9 Protection Member

10 Resin for Closure Reinforcement

11 Protective Coat

12 62 Junction substrate

13 63 Electrode land

14 64 Beer hall

15 65 External terminal

20 Set Substrate

66 Film

67 Closure Resin

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[Translation done.]

* NOTICES *



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DRAWINGS

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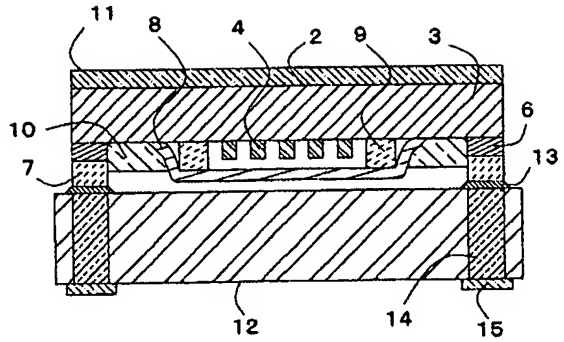
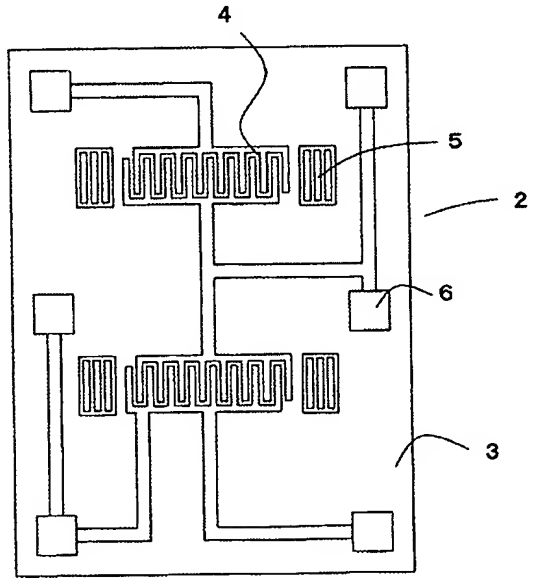
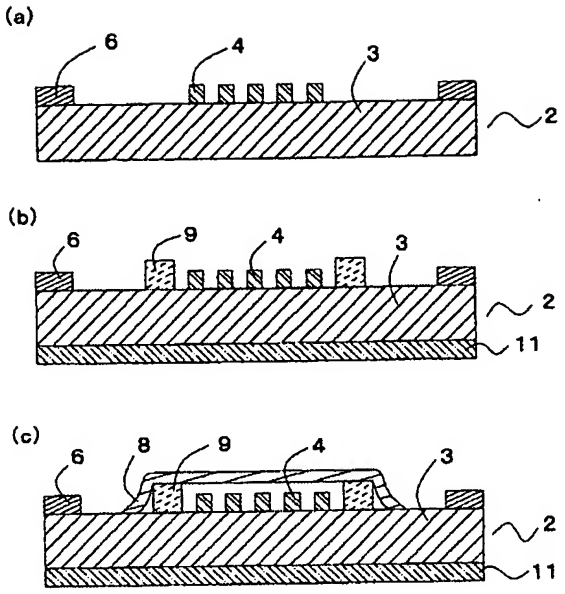
[Drawing 1]



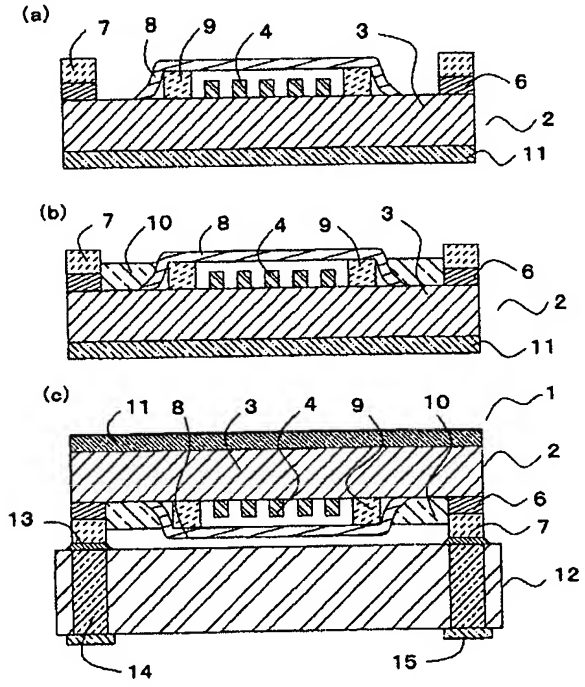

[Drawing 2]



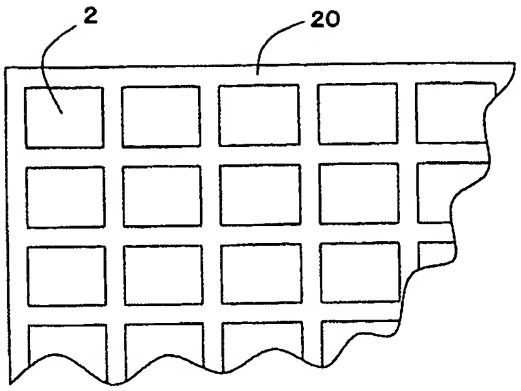

[Drawing 3]



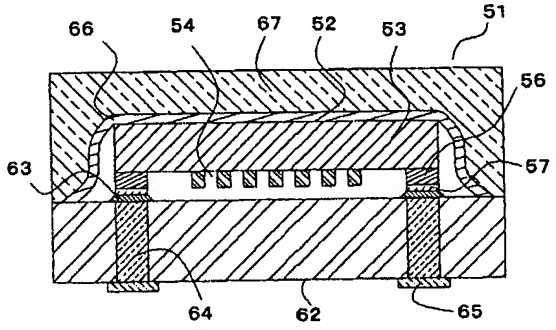

[Drawing 4]




[Drawing 5]




[Drawing 6]

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# PATENT ABSTRACTS OF JAPAN

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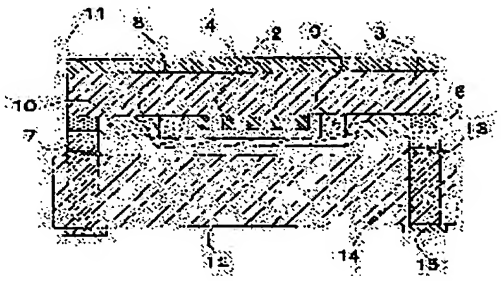
(21)Application number : 2002-314361
(22)Date of filing : 29.10.2002

(71)Applicant : MURATA MFG CO LTD
(72)Inventor : IWAMOTO TAKASHI

## (54) SURFACE ACOUSTIC WAVE DEVICE AND MANUFACTURING METHOD THEREOF

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a small-sized surface acoustic wave device with a low profile and high reliability.
SOLUTION: The surface acoustic wave device 1 comprises: an interdigital electrode section 4 formed on a piezoelectric substrate 3 on the rear side of which a protection film 11 is formed; a reflector (not shown); a protection member 6 formed around a surface part (function part) such as the interdigital electrode section 4 on which a surface acoustic wave is propagated; a surface acoustic wave element 2 formed with the surface part (function part) such as the interdigital electrode section 4 on which the surface acoustic wave is propagated and a protection film 8 adhered to the piezoelectric substrate 3 in a way of covering the protection member 9; a bump 7 formed on the electrode pad 6; a sealing reinforcement resin 10 for covering the adhered part of the protection film 8 to the photoelectric conversion element substrate; and a joining substrate 12 with which the surface acoustic wave element is joined while the face of the surface acoustic wave having the interdigital electrode section 4 is opposed via the bump 7 and which has an electrode land 13, a via-hole 14 and an external terminal 15.




LEGAL STATUS

[Date of request for examination]

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[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

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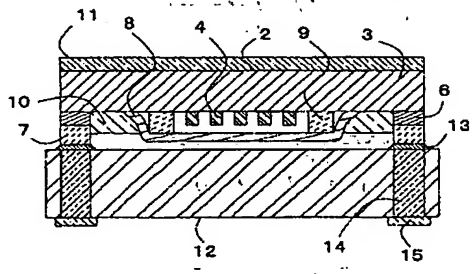
Fターム(参考)　5J097 AA25 AA29 FF04 GG02 GG03
GG04 JJ07 JJ09 JJ10

(54)【発明の名称】弾性表面波装置及びその製造方法

(57)【要約】
【課題】本発明は、小型、低背で且つ信頼性の高い弾性表面波装置を提供する。
【解決手段】本発明の弾性表面波装置１は、裏面に保護膜１１が形成された圧電基板３上に形成されたくし型電極部４、電極パッド６、リフレクタ（図示せず）と、くし型電極部４などの弾性表面波が伝搬する表面部分（機能部分）の周囲に形成された保護部材９と、くし型電極部４などの弾性表面波が伝搬する表面部分（機能部分）と保護部材９を覆うようにして圧電基板３に接着された保護フィルム８とが形成された弾性表面波素子２と、電極パッド６上に形成されたバンプ７と、保護フィルム８の圧電基板の接着部分を覆う封止補強用樹脂１０と、バンプ７を介して弾性表面波素子がくし型電極部４を有する面を対向させて接合される、電極ランド１３と、ビアホール１４と、外部端子１５とを有する接合基板１２からなる。
【選択図】　図１



【特許請求の範囲】
【請求項１】
圧電基板と、該圧電基板上に形成された少なくとも１つのくし型電極部からなる機能部分及びバンプとを有する弾性表面波素子と、
前記圧電基板上で前記機能部分の周囲に形成された保護部材と、
前記機能部分と前記保護部材とを覆うようにして前記圧電基板に接着された保護フィルムと、
前記弾性表面波素子が前記くし型電極部を有する面を対向させて前記バンプで接合された接合基板とを有し、
前記保護フィルムが液晶ポリマーからなることを特徴とする、弾性表面波装置。
【請求項２】
圧電基板と、該圧電基板上に形成された少なくとも１つのくし型電極部からなる機能部分及びバンプとを有する弾性表面波素子と、
前記圧電基板上で前記機能部分の周囲に形成された保護部材と、
前記機能部分と前記保護部材とを覆うようにして前記圧電基板に接着された保護フィルムと、
前記弾性表面波素子が前記くし型電極部を有する面を対向させて前記バンプで接合された接合基板とを有し、
前記保護フィルムが、金属層若しくはセラミックス層を樹脂層で挟んだ多層構造であり、且つ水蒸気透過係数が６．９×１０$^{-11}$［ｇ・ｍ／ｍ$^{2}$・Ｓ］以下であることを特徴とする、弾性表面波装置。
【請求項３】
前記保護フィルムの前記圧電基板との接着部分と、その周囲の圧電基板とを覆うようにして設けられた封止補強用樹脂を更に有することを特徴とする、請求項１、２のいずれかに記載の弾性表面波装置。
【請求項４】
前記接合基板は、外部端子と、電極ランドと、該外部端子と電極ランドを接続するビアホールとを有することを特徴とする、請求項１ないし３のいずれかに弾性表面波装置。
【請求項５】
圧電基板上に少なくとも１つのくし型電極部からなる機能部分を有する弾性表面波素子を複数、作製する工程と、
前記複数の弾性表面波素子の機能部分の周囲に保護部材を形成する工程と、
前記複数の弾性表面波素子の機能部分と前記保護部材とを覆うようにして、液晶ポリマーからなる保護フィルムを熱若しくは圧力の少なくとも一方によって前記圧電基板に接着する工程と、
前記弾性表面波素子にバンプを形成する工程と、
外部端子と、電極ランドと、該外部端子と電極ランドを接続するビアホールとを有する接合基板の集合基板を用意する工程と、
前記複数の弾性表面波素子を、前記くし型電極部を有する面を対向させて前記集合基板に、バンプを介して接合する工程と、
前記集合基板から個々の弾性表面波装置を切り出す工程とを有することを特徴とする、弾性表面波装置の製造方法。
【請求項６】
圧電基板上に少なくとも１つのくし型電極部からなる機能部分を有する弾性表面波素子を複数、作製する工程と、
前記複数の弾性表面波素子の機能部分の周囲に保護部材を形成する工程と、
前記複数の弾性表面波素子の機能部分と前記保護部材とを覆うようにして、金属層若しくはセラミックス層を樹脂層で挟んだ多層構造であり、且つ水蒸気透過係数が６．９×１０$^{-11}$［ｇ・ｍ／ｍ$^{2}$・Ｓ］以下である保護フィルムを熱若しくは圧力の少なくとも一方によって前記圧電基板に接着する工程と、

前記弾性表面波素子にバンプを形成する工程と、
外部端子と、電極ランドと、該外部端子と電極ランドを接続するビアホールとを有する接合基板の集合基板を用意する工程と、
前記複数の弾性表面波素子を、前記くし型電極部を有する面を対向させて前記集合基板に、バンプを介して接合する工程と、
前記集合基板から個々の弾性表面波装置を切り出す工程とを有することを特徴とする、弾性表面波装置の製造方法。
【請求項７】
前記弾性表面波素子にバンプを形成する工程の後、前記保護フィルムの前記圧電基板との接着部分と、その周囲の圧電基板とを封止補強用樹脂で覆う工程を有することを特徴とする、請求項５、６のいずれかに記載の弾性表面波装置の製造方法。
【請求項８】
圧電基板上に少なくとも１つのくし型電極部からなる機能部分を有する弾性表面波素子を複数、作製する工程と、
前記複数の弾性表面波素子の機能部分の周囲に保護部材を形成する工程と、
前記弾性表面波素子にバンプを形成する工程と、
前記複数の弾性表面波素子の機能部分と前記保護部材とを覆うようにして、液晶ポリマーからなる保護フィルムを熱若しくは圧力の少なくとも一方によって前記圧電基板に接着する工程と、
外部端子と、電極ランドと、該外部端子と電極ランドを接続するビアホールとを有する接合基板の集合基板を用意する工程と、
前記複数の弾性表面波素子を、前記くし型電極部を有する面を対向させて前記集合基板に、バンプを介して接合する工程と、
前記集合基板から個々の弾性表面波装置を切り出す工程とを有することを特徴とする、弾性表面波装置の製造方法。
【請求項９】
圧電基板上に少なくとも１つのくし型電極部からなる機能部分を有する弾性表面波素子を複数、作製する工程と、
前記複数の弾性表面波素子の機能部分の周囲に保護部材を形成する工程と、
前記弾性表面波素子にバンプを形成する工程と、
前記複数の弾性表面波素子の機能部分と前記保護部材とを覆うようにして、金属層若しくはセラミックス層を樹脂層で挟んだ多層構造であり、且つ水蒸気透過係数が６．９×１０$^{-14}$［ｇ・ｍ／ｍ$^{2}$・Ｓ］以下である保護フィルムを熱若しくは圧力の少なくとも一方によって前記圧電基板に接着する工程と、
外部端子と、電極ランドと、該外部端子と電極ランドを接続するビアホールとを有する接合基板の集合基板を用意する工程と、
前記複数の弾性表面波素子を、前記くし型電極部を有する面を対向させて前記集合基板に、バンプを介して接合する工程と、
前記集合基板から個々の弾性表面波装置を切り出す工程とを有することを特徴とする、弾性表面波装置の製造方法。
【請求項１０】
前記複数の弾性表面波素子の機能部分と前記保護部材とを覆うようにして保護フィルムを熱若しくは圧力の少なくとも一方によって前記圧電基板に接着する工程の後、前記保護フィルムの前記圧電基板との接着部分と、その周囲の圧電基板とを封止補強用樹脂で覆う工程を有することを特徴とする、請求項８、９のいずれかに記載の弾性表面波装置の製造方法。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】
本発明は、弾性表面波装置に係わり、特にパッケージに弾性表面波素子を搭載した弾性表

面波装置に関する。

【０００２】

【従来の技術】

近年、自動車電話機や携帯電話機といった移動体通信機器の小型化、軽量化、高周波化に伴い、これらの移動体通信機器に搭載されるフィルタとして、小型で軽量な弾性表面波装置が多用されている。

【０００３】

弾性表面波装置においては、圧電基板の表面上を伝搬する弾性表面波を利用するため、この弾性表面波が伝搬する表面部分（機能部分）を水分や埃などから保護する必要がある。よって、従来の弾性表面波装置のパッケージ方法は、アルミナなどからなるパッケージに、ワイヤボンディング若しくはフリップチップボンディングで弾性表面波素子を実装し、蓋材で封止する構造が主流であった。

【０００４】

しかし、このような構造では、微細配線の技術の高度化によって弾性表面波素子を小型化したところで、弾性表面波素子を搭載するパッケージが小型化されない限り、弾性表面波装置の小型化・低背化ができないという問題があった。

【０００５】

そこで、現在、半導体部品の分野で用いられているフリップチップボンディングを用いたチップサイズパッケージを応用した弾性表面波装置が開発されている。

【０００６】

図６を用いて上記の従来の弾性表面波装置を具体的に説明する。圧電基板５３上にくし型電極部５４、電極パッド５６を、Ａｌ等の金属によって形成した弾性表面波素子５２を、電極ランド６３、ビアホール６４、外部端子６５を有する接合基板６２に、くし型電極部５４を有する面を対向させて、フリップチップボンディングで接合する。このとき、弾性表面波素子５２と、外部端子６５とそれにつながるビアホール６４、電極ランド６３とが、バンプ５７を介して、電気的に接続される。そして、くし型電極部５４を含む弾性表面波が伝搬する表面部分（機能部分）を保護するために、弾性表面波素子５２を覆うようにして、プラスチックからなるフィルム６６を接合基板６２に接着する。そして、機密性を高めるために、フィルム６６の上から封止樹脂６７で封止したものが、弾性表面波装置５１である。

【０００７】

また、図６に示した構造で、プラスチックフィルムや導電性フィルム又は金属を付着させたフィルムなどの変形フィルムを接着し、その上で、封止樹脂で封止した構造が知られている（特許文献１参照）。更に、機密性を高めるために、封止樹脂に代えて第２の変形フィルムを用いた構造も開示されている（特許文献１参照）。

【０００８】

【特許文献１】

特開２００１－１７６９９５号公報

【０００９】

【発明が解決しようとする課題】

しかしながら、図６に示した構造及び特許文献１で開示されている構造では、フィルムだけでは機密性が不十分であるために、フィルムの上から封止樹脂で封止するので、樹脂の厚みの分、弾性表面波装置の低背化が困難となってしまう。

【００１０】

更に、弾性表面波素子を覆うようにして、接合基板にフィルムを接着するため、接合基板にはフィルムを接着する部分が必要となり、弾性表面波装置の小型化も困難である。

【００１１】

また、樹脂を用いずに第２の変形フィルムを用いた構造では、変形フィルムの基板との密着性が不十分である場合、機密性が確保できないという問題が発生する。

【００１２】

本発明の弾性表面波装置は、上述の問題を鑑みてなされたものであり、これらの問題を解決し、小型、低背で且つ信頼性の高い弾性表面波装置を提供することを目的としている。

【００１３】

【課題を解決するための手段】

上記目的を達成するため、本発明の弾性表面波装置は、圧電基板と、該圧電基板上に形成された少なくとも１つのくし型電極部からなる機能部分及びバンプとを有する弾性表面波素子と、前記圧電基板上で前記機能部分の周囲に形成された保護部材と、前記機能部分と前記保護部材とを覆うようにして前記圧電基板に接着された保護フィルムと、前記弾性表面波素子が前記くし型電極部を有する面を対向させて前記バンプで接合された接合基板とを有し、前記保護フィルムが液晶ポリマーからなることを特徴とする。

【００１４】

また、本発明のもう一つの弾性表面波装置は、圧電基板と、該圧電基板上に形成された少なくとも１つのくし型電極部からなる機能部分及びバンプとを有する弾性表面波素子と、前記圧電基板上で前記機能部分の周囲に形成された保護部材と、前記機能部分と前記保護部材とを覆うようにして前記圧電基板に接着された保護フィルムと、前記弾性表面波素子が前記くし型電極部を有する面を対向させて前記バンプで接合された接合基板とを有し、前記保護フィルムが、金属層若しくはセラミックス層を樹脂層で挟んだ多層構造であり、且つ水蒸気透過係数が６．９×１０$^{-11}$［ｇ・ｍ／ｍ$^{2}$・Ｓ］以下であることを特徴とする。

【００１５】

前記保護フィルムの前記圧電基板との接着部分と、その周囲の圧電基板とを覆う封止補強用樹脂を更に有することが好ましい。

【００１６】

また、前記接合基板は、外部端子と、電極ランドと、該外部端子と電極ランドを接続するビアホールとを有することが好ましい。

【００１７】

また、本発明の第一の弾性表面波装置の製造方法は、圧電基板上に少なくとも１つのくし型電極部からなる機能部分を有する弾性表面波素子を複数、作製する工程と、前記複数の弾性表面波素子の機能部分の周囲に保護部材を形成する工程と、前記複数の弾性表面波素子の機能部分と前記保護部材とを覆うようにして、液晶ポリマーからなる保護フィルムを熱若しくは圧力の少なくとも一方によって前記圧電基板に接着する工程と、前記弾性表面波素子にバンプを形成する工程と、外部端子と、電極ランドと、該外部端子と電極ランドを接続するビアホールとを有する接合基板の集合基板を用意する工程と、前記複数の弾性表面波素子を、前記くし型電極部を有する面を対向させて前記集合基板に、バンプを介して接合する工程と、前記集合基板から個々の弾性表面波装置を切り出す工程とを有することを特徴とする。

【００１８】

また、本発明の第二の弾性表面波装置の製造方法は、圧電基板上に少なくとも１つのくし型電極部からなる機能部分を有する弾性表面波素子を複数、作製する工程と、前記複数の弾性表面波素子の機能部分の周囲に保護部材を形成する工程と、前記複数の弾性表面波素子の機能部分と前記保護部材とを覆うようにして、金属層若しくはセラミックス層を樹脂層で挟んだ多層構造であり、且つ水蒸気透過係数が６．９×１０$^{-11}$［ｇ・ｍ／ｍ$^{2}$・Ｓ］以下である保護フィルムを熱若しくは圧力の少なくとも一方によって前記圧電基板に接着する工程と、前記弾性表面波素子にバンプを形成する工程と、外部端子と、電極ランドと、該外部端子と電極ランドを接続するビアホールとを有する接合基板の集合基板を用意する工程と、前記複数の弾性表面波素子を、前記くし型電極部を有する面を対向させて前記集合基板に、バンプを介して接合する工程と、前記集合基板から個々の弾性表面波装置を切り出す工程とを有することを特徴とする。

【００１９】

なお、本発明の第一及び第二の弾性表面波装置の製造方法においては、前記弾性表面波素

子にバンプを形成する工程の後、前記保護フィルムの前記圧電基板との接着部分と、その周囲の圧電基板とを封止補強用樹脂で覆う工程を有することが好ましい。

【００２０】

また、本発明の第三の弾性表面波装置の製造方法は、圧電基板上に少なくとも１つのくし型電極部からなる機能部分を有する弾性表面波素子を複数、作製する工程と、前記複数の弾性表面波素子の機能部分の周囲に保護部材を形成する工程と、前記弾性表面波素子にバンプを形成する工程と、前記複数の弾性表面波素子の機能部分と前記保護部材とを覆うようにして、液晶ポリマーからなる保護フィルムを熱若しくは圧力の少なくとも一方によって前記圧電基板に接着する工程と、外部端子と、電極ランドと、該外部端子と電極ランドを接続するビアホールとを有する接合基板の集合基板を用意する工程と、前記複数の弾性表面波素子を、前記くし型電極部を有する面を対向させて前記集合基板に、バンプを介して接合する工程と、前記集合基板から個々の弾性表面波装置を切り出す工程とを有することを特徴とする。

【００２１】

また、本発明の第四の弾性表面波装置の製造方法は、圧電基板上に少なくとも１つのくし型電極部からなる機能部分を有する弾性表面波素子を複数、作製する工程と、前記複数の弾性表面波素子の機能部分の周囲に保護部材を形成する工程と、前記弾性表面波素子にバンプを形成する工程と、前記複数の弾性表面波素子の機能部分と前記保護部材とを覆うようにして、金属層若しくはセラミックス層を樹脂層で挟んだ多層構造であり、且つ水蒸気透過係数が６．９×１０$^{-11}$［ｇ・ｍ／ｍ$^{2}$・Ｓ］以下である保護フィルムを熱若しくは圧力の少なくとも一方によって前記圧電基板に接着する工程と、外部端子と、電極ランドと、該外部端子と電極ランドを接続するビアホールとを有する接合基板の集合基板を用意する工程と、前記複数の弾性表面波素子を、前記くし型電極部を有する面を対向させて前記集合基板に、バンプを介して接合する工程と、前記集合基板から個々の弾性表面波装置を切り出す工程とを有することを特徴とする。

【００２２】

なお、本発明の第三及び第四の弾性表面波装置の製造方法においては、前記複数の弾性表面波素子の機能部分と前記保護部材とを覆うようにして保護フィルムを熱若しくは圧力の少なくとも一方によって前記圧電基板に接着する工程の後、前記保護フィルムの前記圧電基板との接着部分と、その周囲の圧電基板とを封止補強用樹脂で覆う工程を有することが好ましい。

【００２３】

【発明の実施の形態】

以下、本発明の実施例を、図に基づいて説明する。

図１は本発明における弾性表面波装置の実施例を示す断面図、図２は本発明の実施例における弾性表面波素子の平面図、図３は本発明の実施例における弾性表面波装置の製造方法の各工程図、図４は本発明の実施例における弾性表面波装置の製造方法の各工程図、図５は本発明の実施例における集合基板（接合基板）に実装された弾性表面波素子の平面図である。

【００２４】

本発明の弾性表面波装置１は、図１に示すように、弾性表面波素子２と接合基板１２とで構成されている。弾性表面波素子２は、裏面に保護膜１１が形成された圧電基板３と、この圧電基板３上に形成されたくし型電極部４、リフレクタ（図示せず）、電極パッド６と、くし型電極部４などの弾性表面波が伝搬する表面部分（機能部分）の周囲に形成された、電極膜厚よりも厚い保護部材９と、上記した機能部分と保護部材９を覆うようにして圧電基板３に接着された保護フィルム８と、保護フィルム８の圧電基板の接着部分とその周囲の圧電基板３を覆う封止補強用樹脂１０で構成されている。なお、保護フィルム８は、保護部材９と密着するが、くし型電極部４、リフレクタ（図示せず）、電極パッド６などと接触することがないように形成されている。

【００２５】

弾性表面波素子２は、電極ランド１３と、ビアホール１４と、外部端子１５とを有する接合基板１２に対して、くし型電極部４を有する面を対向させた状態で、電極パッド６上に形成されたバンプ７を介して接合される。

【００２６】

弾性表面波素子２の裏面は、ＬｉＴａＯ３などの圧電基板を用いた際に圧電基板の割れを防止する保護膜１１が形成されているだけであり、弾性表面波装置１は小型で且つ低背な構造となっている。なお、圧電基板が割れにくいのであれば、この保護膜１１を形成する必要はない。

【００２７】

本発明で用いる保護フィルム８は、弾性表面波が伝搬する表面部分（機能部分）を特に水分から保護するために高バリア性である必要がある。そこで、様々なフィルムを用意して評価を行なった。以下の評価は、周波数特性が１．９ＧＨｚである弾性表面波素子を用いて、フィルムのみを異ならせた上での評価である。なお、特性評価時の良品、不良品の判断は、挿入損失が０．３ｄＢ以上悪化した場合を不良品とした。

【００２８】

まず、ポリイミドからなる単層のフィルムと、ポリイミドとＡｌ２Ｏ３からなる多層構造のフィルムとを用いて、保護フィルム８の水蒸気透過係数と弾性表面波装置の特性良品率の相関関係を調査した。このとき、保護フィルムの全膜厚は１００μｍとなるようにした。これは、実際に弾性表面波装置に用いる場合、保護フィルムが厚くなると、その分だけバンプを高くする必要があり、低背化のためにはバンプの高さが低ければ低いほど好ましいと共に、１００μｍ以上のバンプを作るのは困難且つ高コストであることを考慮したためである。

【００２９】

なお、多層構造のフィルムは、ポリイミド上にＡｌ２Ｏ３を成膜し、徐々にＡｌ２Ｏ３の膜厚を増やすことによって、保護フィルムの水蒸気透過係数を変化させたサンプルを用意し、それぞれについて信頼性試験を行なった。

【００３０】

評価サンプルは、弾性表面波素子の弾性表面波が伝搬する表面部分（機能部分）の周囲に保護部材を形成した上で、弾性表面波が伝搬する表面部分（機能部分）と保護部材を覆うようにして圧電基盤に保護フィルムを接着した構造で行い、湿中試験槽２０００時間放置後の特性良品数で評価した。

【００３１】

ここで、特性の評価に用いる水蒸気透過係数は、単位時間（Ｓ）、単位面積（ｍ２）あたりに、厚みが１ｍの保護フィルムで、どれだけの重量（ｇ）の水蒸気が透過するかを表す係数［ｇ・ｍ／ｍ２・Ｓ］である。水蒸気透過係数は、単位厚み当たりの水蒸気透過量を示すもので、フィルム厚に関係ない値であり、係数が小さいほど、水蒸気に対するバリアとしての効果が大きいということになる。

【００３２】

評価試験の結果は、▲１▼ポリイミド（１００μｍ）：２．３×１０$^{-8}$［ｇ・ｍ／ｍ２・Ｓ］＝１／１００（評価サンプル１００個あたり、良品サンプルが１個であることを意味する。以下も同様。）、▲２▼ポリイミド（９９．５μｍ）＋Ａｌ２Ｏ３（０．５μｍ）：９．７×１０$^{-10}$［ｇ・ｍ／ｍ２・Ｓ］＝９／１００、▲３▼ポリイミド（９９μｍ）＋Ａｌ２Ｏ３（１μｍ）：６．９×１０$^{-11}$［ｇ・ｍ／ｍ２・Ｓ］＝９１／１００、▲４▼ポリイミド（９５μｍ）＋Ａｌ２Ｏ３（５μｍ）：３．５×１０$^{-11}$［ｇ・ｍ／ｍ２・Ｓ］＝９９／１００、▲５▼ポリイミド（９０μｍ）＋Ａｌ２Ｏ３（１０μｍ）：１．２×１０$^{-11}$［ｇ・ｍ／ｍ２・Ｓ］＝９９／１００、▲６▼ポリイミド（８０μｍ）＋Ａｌ２Ｏ３（２０μｍ）：８．８×１０$^{-12}$［ｇ・ｍ／ｍ２・Ｓ］＝１００／１００、▲７▼ポリイミド（７５μｍ）＋Ａｌ２Ｏ３（２５μｍ）：５．０×１０$^{-12}$［ｇ・ｍ／ｍ２・Ｓ］＝１００／１００、▲８▼ポリイミド（５０μｍ）＋銅箔（２５μｍ）＋Ａｌ２Ｏ３（２５μｍ）：５．０×１０$^{-13}$［ｇ・ｍ／ｍ２・Ｓ］＝１００／１０

０であった。

【００３３】

以上の結果から、$Al_2O_3$の厚みを増やして、保護フィルムの水蒸気透過係数を小さくするほど、特性が劣化しにくくなることがわかる。特に、水蒸気透過係数が、６．９×１０$^{-11}$［ｇ・ｍ／ｍ$^2$・Ｓ］のとき、保護フィルムのバリア性のみで９０％以上が特性良品基準を維持できることがわかる。さらに、３．５×１０$^{-11}$［ｇ・ｍ／ｍ$^2$・Ｓ］以下では、保護フィルムのバリア性のみで９９％以上が特性良品基準を維持できることがわかる。今回は、樹脂層としてポリイミドフィルムを用いたが、これに限らず、ポリエチレンナフタレートなど耐熱性のあるフィルムであれば良い。

【００３４】

また、上記の結果は、ポリイミドからなる単層のフィルムと、ポリイミドと$Al_2O_3$からなる多層構造のフィルムのものであるが、単層のフィルムで水蒸気透過係数が、６．９×１０$^{-11}$［ｇ・ｍ／ｍ$^2$・Ｓ］以下となる材料としては、液晶ポリマーがある。液晶ポリマーの水蒸気透過係数は、３．０×１０$^{-11}$［ｇ・ｍ／ｍ$^2$・Ｓ］、特性良品率は１００／１００であり、液晶ポリマーからなる保護フィルムを用いれば、単層であっても高い信頼性を得ることができる。

【００３５】

多層構造のフィルムにおいては、水蒸気透過係数を小さくすると共に、シールド効果をフィルムにもたせるために、樹脂層間に銅箔等の金属層を形成する場合がある。しかしながら、樹脂層と金属層とは基本的に密着力が弱い上に、金属層を有するフィルムがバンプなどと接触するとショートする可能性がある。これらの問題点に加えて、多層構造を形成するプロセスが複雑であるため、１層で高いバリア性を得られる液晶ポリマーを保護フィルム８として用いることが好ましい。

【００３６】

本発明に係る弾性表面波装置１の製造方法は以下の通りである。

【００３７】

まず、圧電基板３上に、レジストを塗布した後、マスクを用いて露光するというフォトリソグラフィー技術を用いて、所望の開口パターンを有するリフトオフ用レジストパターン（図示せず）を形成する。

【００３８】

次に、電極材料金属であるＡｌを蒸着法などにより成膜した後、レジスト剥離液に浸漬・揺動させてレジストパターンを剥離（リフトオフ）することで、図３（ａ）に示すように、圧電基板３上にくし型電極部４、リフレクタ５、電極パッド６や引き回し配線などを形成し、図２に示すような弾性表面波素子２を作製する。

【００３９】

圧電基板としては、目標特性に応じて、$LiTaO_3$、$LiNbO_3$、水晶、$Li_2B_4O_7$等を用いる。また、電極材料としては、Ａｌ以外に、Ａｕ、Ｃｕ、Ｎｉ、Ｔａ、Ｗ等の金属材料を用いることが可能である。

【００４０】

続けて、圧電基板３のくし型電極部４などを形成した面に、感光性樹脂を塗布し、マスクを用いて露光するというフォトリソグラフィー技術を用いて、図３（ｂ）に示すように、くし型電極部４よりも厚い樹脂パターンからなる保護部材９を、くし型電極部４などの弾性表面波が伝搬する表面部分（機能部分）を取り囲むように環状に形成する。このとき、保護部材９の厚みとしては、後に記述する保護フィルム８がくし型電極部４、リフレクタ５に接触することを防ぐことが出来ればよい。例えば、くし型電極部４、リフレクタ５の厚みが約０．２μｍの場合、保護部材９の厚みは約５μｍあればよい。それと共に、圧電基板３のくし型電極部４などを形成されていない面に、エポキシ樹脂やポリイミドといった樹脂からなる保護膜１１を形成する。圧電基板３として、割れやすい$LiTaO_3$基板を用いた場合、保護膜１１を形成することで基板の割れを防止することが出来る。

【００４１】

くし型電極部４などの弾性表面波が伝搬する表面部分（機能部分）と保護部材９を覆うために用いる保護フィルム８を用意する。保護フィルム８としては、厚さ４４μｍの液晶ポリマーからなるものを用いる。液晶ポリマーは上記の評価の結果から分かるように、水蒸気透過係数が３．０×１０$^{-11}$［ｇ・ｍ／ｍ$^{2}$・Ｓ］と高いバリア性を有するので、弾性表面波素子２の機能部分を水分や埃から保護するには好適である。

【００４２】

なお、本実施例では、保護フィルム８として液晶ポリマーからなるフィルムを用いたが、本発明はこれに限らず、樹脂層の間に金属層やセラミックス層を有するなどの多層構造を有するフィルムを用いても良い。水蒸気透過係数が６．９×１０$^{-11}$［ｇ・ｍ／ｍ$^{2}$・Ｓ］以下であれば、保護フィルム８だけで弾性表面波が伝搬する表面部分（機能部分）を水分や埃から保護することが出来る。

【００４３】

多層構造のフィルムは、表面が研磨されたＳｉ基板を用意し、Ｓｉ基板上に厚さ２５μｍのポリイミドフィルムを仮接着させ、その上に圧延により形成された厚さ１０μｍの銅箔を貼り、さらにその上に、厚さ２５μｍのポリイミドフィルムを貼り、プレス機により圧力をかけながら加熱し、ポリイミドフィルムと銅箔を圧着する。さらにその上に接着剤層を塗布するなどして、形成すれば良い。

【００４４】

用意した保護フィルム８で、弾性表面波素子２の機能部分と保護部材と９を覆い、図３（ｃ）に示すように、保護フィルム８を圧電基板３に熱圧着させる。このとき、接着温度は、３００℃であり、保護フィルム８が加工しやすくなると共に、熱による電極の酸化や拡散が問題とならない温度となっている。こうすることにより、弾性表面波の振動空間を確保しつつ、保護フィルム８によって弾性表面波素子２の機能部分を水分や埃などから保護することが可能となる。

【００４５】

そして、図４（ａ）に示すように、電極パッド６上にＡｕからなるバンプ７を形成する。バンプ７の高さは２０～３０μｍとする。本実施例では、バンプ７としてＡｕからなるバンプを用いたが、これに限らず、半田からなるバンプを用いても良い。但し、Ａｕ－Ｓｎ系やＳｎ－Ａｇ系の半田からなるバンプを用いる場合には、半田からなるバンプの密着層として、電極パッド６上にＮｉ層を形成することが好ましい。

【００４６】

また、本実施例では、保護フィルム８を弾性表面波素子２の圧電基板３に接着した後バンプ７を形成したが、本発明はこれに限らず、バンプ７を形成した後、保護フィルム８を弾性表面波素子２の圧電基板３に接着しても良い。

【００４７】

図４（ｂ）に示すように、弾性表面波素子２において、保護フィルム８の圧電基板３との接着部分を覆うように、封止補強用樹脂１０を塗布、硬化させる。封止補強用樹脂１０は、封止補強用樹脂１０の表面の高さが、バンプ７及び保護部材９上の保護フィルム８よりも低くなるような厚みであり、具体的には１０～１５μｍである。こうようにすることで、保護フィルム８の圧電基板３との接着強度を補強し、保護フィルム８による弾性表面波が伝搬する表面部分（機能部分）の封止の気密性を高めることが出来る。

【００４８】

そして、後に接合基板１２となる集合基板２０を用意する。集合基板２０（接合基板１２）には、弾性表面波素子２の電極パッド６に対応する電極ランド１３、外部端子１５、電極ランド１３と外部端子１５とを電気的に接続するスルーホール１４が形成されている。電極ランド１３の表面は、Ａｕめっきされていることが好ましい。バンプ７もＡｕからなるため、弾性表面波素子２と接合基板１２とを接合する際、接合強度を高めることが出来る。

【００４９】

図４に示すように、用意した集合基板２０に、複数の弾性表面波素子２をフリップチップ

ボンディングで接合する。弾性表面波素子２の電極パッド６と集合基板２０の電極ランド１３は、バンプ７を介して電気的にも機械的にも接続される。

【００５０】

最後に、集合基板２０からダイシングによって、図４（ｃ）に示すように弾性表面波装置１が得られる。

【００５１】

【発明の効果】

以上のように、本発明の弾性表面波装置は、圧電基板上に形成されたくし型電極部、電極パッド、リフレクタと、くし型電極部などの弾性表面波が伝搬する表面部分（機能部分）の周囲に形成された保護部材と、くし型電極部などの弾性表面波が伝搬する表面部分（機能部分）と保護部材を覆うようにして圧電基板に接着された高バリア性の保護フィルムとが形成された弾性表面波素子と、電極パッド上に形成されたバンプと、保護フィルムの圧電基板の接着部分を覆う封止補強用樹脂と、バンプを介して弾性表面波素子がくし型電極部を有する面を対向させて接合される、電極ランドと、ビアホールと、外部端子とを有する接合基板からなり、このような構造にすることで、弾性表面波の振動空間を確保しつつ、圧電基板における、くし型電極部などの弾性表面波が伝搬する表面部分（機能部分）が、液晶ポリマーからなる保護フィルム若しくは水蒸気透過係数が６．９×１０$^{-11}$［ｇ・ｍ／ｍ$^{2}$・Ｓ］以下の多層構造の保護フィルムによって気密封止され、弾性表面波素子を樹脂封止する必要もないので、小型化、低背化が可能となる。

【００５２】

また、保護フィルムの圧電基板との接着部分と、その周囲の圧電基板を封止補強用樹脂で覆っているので、保護フィルムの圧電基板との接着強度を補強し、保護フィルムによる弾性表面波が伝搬する表面部分（機能部分）の封止の気密性を高めることが出来る。

【図面の簡単な説明】

【図１】本発明における弾性表面波装置の実施例を示す断面図である。

【図２】本発明の実施例における弾性表面波素子の平面図である。

【図３】本発明の実施例における弾性表面波装置の製造方法の各工程図である。

【図４】本発明の実施例における弾性表面波装置の製造方法の各工程図である。

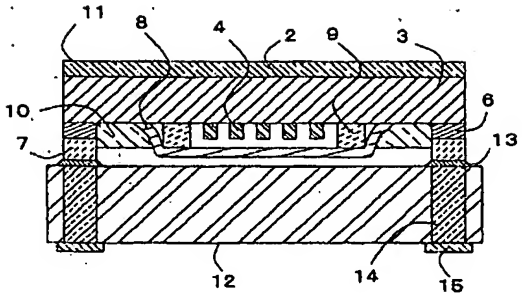
【図５】本発明の実施例における集合基板（接合基板）に実装された弾性表面波素子の平面図である。

【図６】従来の弾性表面波装置の断面図である。

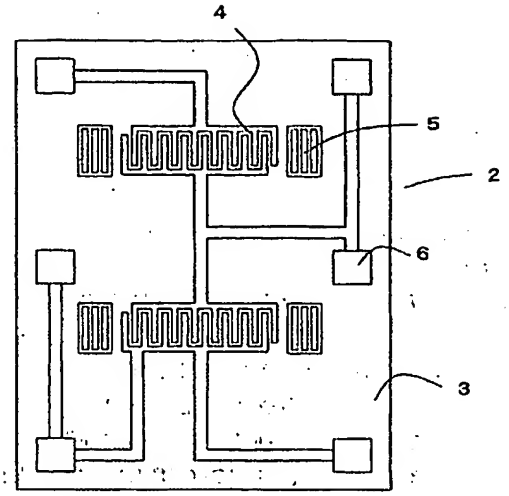
【符号の説明】

１、５１　弾性表面波装置
２、５２　弾性表面波素子
３、５３　圧電基板
４、５４　くし型電極部
５　リフレクタ
６、５６　電極パッド
７、５７　バンプ
８　保護フィルム
９　保護部材
１０　封止補強用樹脂
１１　保護膜
１２、６２　接合基板
１３、６３　電極ランド
１４、６４　ビアホール
１５、６５　外部端子
２０　集合基板
６６　フィルム
６７　封止樹脂

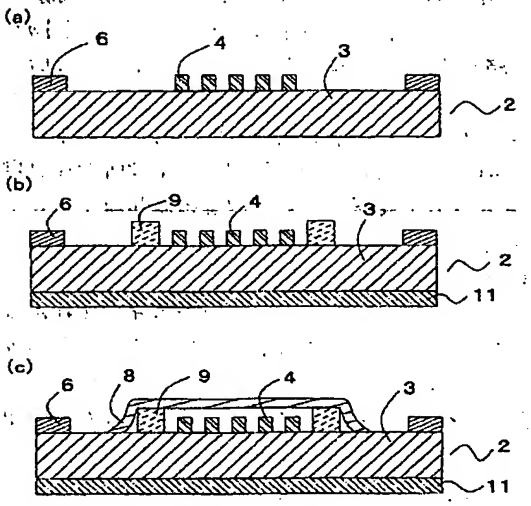
【図１】


11
8
4
2
9
3
10
6
7
13
12
14
15

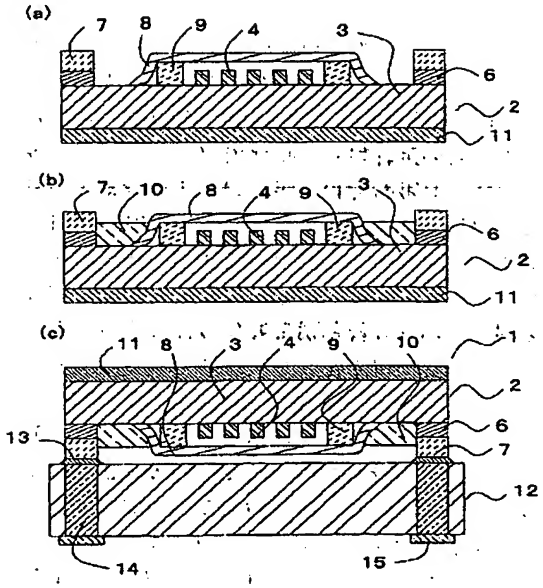
【図２】


4
5
2
6
3

【図３】


(a)
6
4
3
2
(b)
6
9
4
3
2
11
(c)
6
8
9
4
3
2
11

【図４】


(a)
7
8
9
4
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(b)
7
10
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4
9
3
6
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(c)
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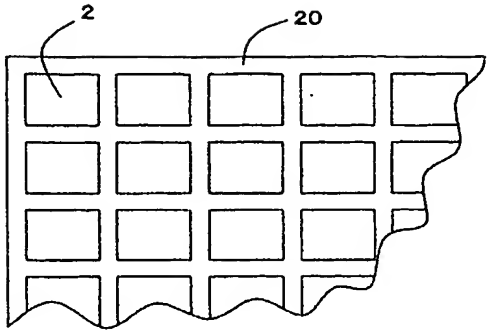
15

【図５】




【図６】